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# 1. INTRODUCTION

The EIRENE user strategy aims to engage and meet the needs of a diverse community of users, including scientists, policymakers, private sector stakeholders, and the general public. EIRENE will provide high-quality, integrated data and services in the field of exposome and environmental health research. This strategy is designed to offer access to digital platforms, innovative analytical tools, training opportunities, and collaborative resources tailored to the specific needs of users involved in exposome-related research.

Currently, in its Preparatory Phase (PPP), the EIRENE user strategy is continuously evolving, focusing on the design, testing, and optimization of services to ensure they meet the evolving needs of users. The strategy will be adjusted through a cyclic process of feedback collection and improvement, ensuring alignment with the overall vision of EIRENE as it moves towards full operational capacity.

EIRENE Service Access Rules & Procedures, D2.3 emphasize the importance of structured user access procedures, including physical, remote, virtual, and hybrid access modes. The document outlines the key elements of the open access system, such as a centralized web portal, transparent proposal evaluation criteria, and streamlined procedures for researchers and stakeholders. The evaluation framework ensures that access to EIRENE services is equitable, scientifically rigorous, and aligned with Open Science principles. These structured procedures will enhance user experience by simplifying access requests, facilitating collaborations, and ensuring EIRENE's resources are efficiently allocated to high-impact research initiatives.

Stakeholder Engagement and Impact Assessment insights from D8.2 highlight the need for an inclusive Stakeholder Engagement Strategy, ensuring direct and indirect users, including policymakers, industry representatives, and research institutions, are actively involved. To foster global collaboration, the engagement strategy aligns with international exposome research efforts, such as the International Human Exposome Network (IHEN). Strategic partnerships with ESFRI RIs, environmental agencies, and funding bodies will enhance EIRENE's visibility and ensure sustainability.

Findings from D8.3 reinforce the importance of Key Performance Indicators (KPIs) to measure the effectiveness of EIRENE's user strategy. The proposed KPIs include:

- User access metrics: Number of user requests, accepted applications, and active collaborations.
- Scientific output: Number of peer-reviewed publications and citations.
- Service utilization: Ratio of services provided versus available infrastructure.
- Stakeholder engagement: Level of involvement of policymakers, industry partners, and NGOs.

These KPIs will guide continuous improvement, ensuring EIRENE remains a leading research infrastructure in exposome science.

The present document (D6.3) provides a comprehensive overview of the key components of EIRENE's user strategy, highlighting the necessity of a well-structured roadmap to facilitate efficient service delivery, mitigate anticipated challenges, and establish mechanisms for long-term sustainability. By emphasizing adaptability and continuous improvement, EIRENE aims to position itself as a leading resource for exposome research and environmental health, fostering collaboration and driving scientific progress in the field.

In EIRENE, we define „**Users**“ as individuals and organisations who actively use EIRENE's services—researchers working with exposome data, public health experts using our tools, or companies collaborating on innovation. **Stakeholders**, meanwhile, are those who may not directly use the services, but still have an important role or interest in EIRENE—like funders, policymakers, partner infrastructures, or community groups. Recognising this difference helps us better shape the services we provide while also building strong, long-term partnerships that support the growth and sustainability of the infrastructure.“

## 2. EIRENE USER STRATEGY

### 2.1 CONTEXT

The EIRENE user strategy defines the goals, priorities, and actions required to deliver services that meet the needs of its user community, ensuring that their expectations are fulfilled through accessible and efficient processes. Since EIRENE is still in the Preparatory Phase, the user strategy cycle primarily focuses on designing, testing, and refining services that will be operationalized as the infrastructure moves toward full implementation. The strategy revolves around five core elements:

- **User attraction and acquisition:** Establishing a robust communication and outreach strategy to attract diverse users from multiple sectors.
- **User understanding:** Engaging in continuous dialogue with early-stage users and conducting active monitoring to assess and respond to user needs.
- **User experience:** Optimizing interactions between users and the infrastructure, ensuring smooth access to data and digital tools while maintaining high service quality.
- **User-oriented services and processes:** Improving the service portfolio by incorporating user feedback, developing new services, and ensuring a streamlined and efficient access system.
- **User feedback and adaptation:** Establishing structured mechanisms for gathering and analysing user feedback, ensuring continuous service optimization.

The role of pilot studies and testing in refining access systems and service designs is crucial. Pilot testing helps to evaluate the effectiveness of physical, remote, and virtual access mechanisms, ensuring that EIRENE's infrastructure is user-centred and responsive to diverse research needs. Additionally, stakeholder engagement strategies outlined in D8.2 highlight the need for direct

involvement of policymakers, industry partners, and research institutions. This engagement ensures that EIRENE aligns with international exposome research efforts, fostering global collaboration and sustainability.

EIRENE serves a broad and diverse user base, including scientists, policymakers, private sector representatives, and NGOs. These groups rely on EIRENE's services for various purposes, including data analysis, collaborative research, and evidence-based policymaking. Findings from D8.3 stress the importance of Key Performance Indicators (KPIs) to measure user engagement, service efficiency, and research impact. These KPIs provide a framework for monitoring and optimizing the EIRENE user strategy, ensuring that services remain aligned with user expectations and needs.

## 2.2 USER RESPONSES

To inform the development of a user-focused infrastructure, EIRENE PPP organized two online user strategy workshops in April 2025. These workshops targeted potential users, including representatives from government agencies, regulatory bodies, research institutions, NGOs, and policy support organizations. Each session included presentations and interactive discussions using Mentimeter, enabling participants to express priorities and expectations.

Key findings from the workshops include:

- **Strong demand for cloud-based services and remote access tools** to facilitate efficient and decentralized exposome research.
- **High value placed on data interpretation support**, with many participants emphasizing the need for EIRENE to offer analytical guidance and standardized workflows.
- **Preferred communication channels** included the EIRENE website, targeted newsletters, and structured webinars. Email updates and live Q&A sessions were also suggested for real-time engagement.
- Participants emphasized the **importance of training**, particularly through webinars, physical access workshops, and modular, step-by-step documentation. There was also interest in hands-on training in laboratories and with wearable monitoring devices.
- **Live updates on analytical protocols**, a user forum, and regular feedback loops were proposed as mechanisms to strengthen community engagement and knowledge exchange.
- **Policy-driven organizations** were highlighted as priority stakeholders requiring tailored access and interpretive support.
- Although no new service types were explicitly requested, participants noted that **additional needs would likely emerge** as the infrastructure becomes operational, reinforcing the need for a flexible and adaptive support model.

A complete summary of the feedback is provided in Appendix 1.

In summary, the workshops confirmed that EIRENE's user strategy must prioritize **flexibility, digital accessibility, structured training, and open communication mechanisms**. The proactive engagement

model tested in these workshops will serve as a foundation for iterative development and long-term community building within EIRENE's user base.

## 2.3 BENEFITS OF EIRENE SERVICES TO ITS USER COMMUNITIES

The benefits of accessing EIRENE's services vary across its user base, depending on their goals and the required tools or data. EIRENE provides a structured, interoperable, and transparent framework that facilitates access to its infrastructure, supporting scientific excellence, policy development, and societal engagement. It is clear that structured access mechanisms and pilot-tested services are needed to ensure that user needs are met efficiently. Additionally, stakeholder engagement strategies from D8.2 and performance metrics from D8.3 provide key indicators for assessing the impact of EIRENE services (Table 1).

### **Scientific Community**

Researchers benefit from access to cutting-edge exposome data, advanced analytical tools, and international collaboration opportunities. Open science initiatives and standardized methodologies ensure that data is shareable and reusable, fostering scientific progress. EIRENE is also committed to strengthening its ties with the global scientific community, including research partners in the USA, Australia, and beyond, where significant exposome and environmental health initiatives are ongoing. These collaborations will support knowledge exchange, alignment of protocols, and shared development of research tools. At the same time, EIRENE will actively seek synergies with other European research infrastructures such as BBMRI-ERIC, ACTRIS, ECRIN, and ELIXIR. These partnerships will help integrate biobanking, clinical research, atmospheric monitoring, and life science data services—further enriching the research landscape and enabling more holistic exposome investigations.

### **Private Sector**

Actors in biotech, environmental monitoring, and health industries gain access to new data sources for innovation. EIRENE facilitates knowledge transfer and research partnerships, enhancing industry competitiveness and promoting sustainable business solutions.

**Policy Makers** EIRENE provides policymakers with evidence-based insights to guide public health and environmental policies. Access to validated datasets and regulatory indicators supports informed decision-making and the development of robust regulatory frameworks.

### **Ministries and Funding Agencies**

Government bodies and funding organizations can use EIRENE to structure research investments and optimize resource allocation. Strategic alignment with European and international exposome initiatives ensures the long-term sustainability of infrastructure and funding opportunities.

### **NGOs and Public Sector**

EIRENE enables public sector engagement in environmental health research, fostering data-driven approaches to societal challenges. Citizen science initiatives and participatory research models empower communities to contribute to exposome research, increasing awareness of environmental risks.

Findings from D8.2 emphasize the role of public engagement in strengthening the societal impact of EIRENE. Integrating participatory research methodologies ensures that EIRENE’s research outcomes remain accessible and actionable, bridging the gap between scientific discovery and public health interventions.

Table 1 EIRENE user communities

EIRENE User Communities	Benefits
<b>Scientific Community</b>	<ul style="list-style-type: none"> <li>– Access to cutting-edge exposome data and advanced analytical tools</li> <li>– International collaboration and visibility, including engagement with global exposome initiatives (e.g. USA, Australia)</li> <li>– Open science and data sharing through standardized methodologies</li> <li>– Integration with other European research infrastructures (BBMRI, ACTRIS, ECRIN, ELIXIR)</li> <li>– Pilot-tested access to harmonized tools and services</li> </ul>
<b>Private Sector</b>	<ul style="list-style-type: none"> <li>- Access to new data for innovation in biotech and environmental solutions</li> <li>- R&amp;D support and knowledge transfer</li> <li>- Increased competitiveness</li> <li>- Structured access procedures for industry collaborations (D4.1)</li> </ul>
<b>Policy Makers</b>	<ul style="list-style-type: none"> <li>- Evidence-based decision-making on public health and environmental issues</li> <li>- Data for developing regulations</li> <li>- Support for health policy networks</li> <li>- Access to validated datasets and indicators supporting regulatory frameworks (D8.3)</li> </ul>
<b>Ministries and Funding Agencies</b>	<ul style="list-style-type: none"> <li>- Structuring research investment opportunities</li> <li>- Strategic partnerships for research initiatives</li> <li>- Optimized resource use</li> <li>- Alignment with European and international exposome strategies (D8.2)</li> </ul>
<b>NGOs and Public Sector</b>	<ul style="list-style-type: none"> <li>- Increased awareness of health and environmental risks</li> <li>- Data-driven approaches to health challenges</li> <li>- Contributions to public health outcomes</li> <li>- Expanded engagement through citizen science and participatory approaches,</li> <li>- Empowering communities to contribute to exposome research (D8.2)</li> </ul>

## 2.4 RECOMMENDATIONS FOR A SUCCESSFUL USER STRATEGY

As EIRENE progresses through the Preparatory Phase, a set of recommendations has been developed to ensure an effective, inclusive, and adaptable user strategy. Insights from D4.1, D4.2, D8.2, and D8.3 emphasize the importance of proactive engagement, structured access mechanisms, and impact assessment (Table 2).



- **Broad user engagement:** Implement tailored communication strategies to reach scientific, private, and public-sector audiences.
- **Building trust and relationships:** Foster transparent interactions with users to ensure inclusivity and long-term engagement.
- **Monitoring of evolving user needs:** Use pilot studies and structured feedback mechanisms to continuously adapt services and tools.
- **Documentation and performance tracking:** Maintain detailed records of user access and service utilization to evaluate impact and optimize workflows.
- **Open access commitment:** Ensure services are guided by FAIR principles, promoting scientific progress and data sharing.
- **Stakeholder alignment:** Establish partnerships with policymakers, industry/business , and NGOs to strengthen EIRENE's impact and sustainability.
- **KPI-based performance evaluation:** Apply indicators from D8.3 to monitor user satisfaction, service efficiency, and research impact.

Findings from D8.2 emphasize the importance of stakeholder engagement in refining EIRENE's infrastructure. Training programs and structured onboarding processes will facilitate the seamless adoption of EIRENE's tools and services across various user groups.

Table 2 Recommendations for EIRENE user strategy

Recommendations for EIRENE User Strategy	Details	Key Performance Indicator (KPI)
<b>Broad user engagement</b>	EIRENE should strive to reach diverse target audiences within the scientific, private, and public sectors through conferences, training and social media.	Number of new user registrations, diversity of user demographics, and engagement in outreach events.
<b>Building trust and relationships</b>	Foster strong, transparent relationships with users to ensure they feel supported and valued.	User satisfaction scores, number of returning users, and feedback on transparency and support.
<b>Monitoring evolving user needs</b>	Continuously track user feedback and anticipate emerging needs, especially for innovative services and technological tools.	Frequency of user surveys, number of feature requests, and adaptation rate of new services.
<b>Documentation and statistics</b>	Maintain detailed records of user access and service utilization to track EIRENE's impact and relevance to its community.	Volume of data access logs, user activity tracking, and service utilization trends.
<b>Proactive user feedback response</b>	Analyse feedback efficiently and publicly communicate actions taken to maintain transparency and trust.	Average response time to user feedback, percentage of resolved issues, and transparency reports.
<b>Service catalogue updates</b>	Regularly update the EIRENE service catalogue to keep users informed of new opportunities and tools.	Frequency of service catalogue updates, user awareness of new services, and usage statistics.
<b>Open access</b>	Ensure open access to services guided	Percentage of services available as

<b>commitment</b>	by principles promoting scientific progress, data sharing, and collaboration.	open access, citation rate of EIRENE tools and data.
<b>User-centric approach</b>	Prioritize the needs of the user community in the design, implementation, and expansion of services.	User retention rate, usability scores, and direct user contributions to service development.
<b>Stakeholder alignment</b>	Integrate stakeholder engagement strategies from D8.2 to build robust partnerships with policymakers, industry/business, and NGOs.	Number of stakeholder partnerships, level of policy integration, and collaborative project outputs.
<b>KPIs for performance tracking</b>	Leverage KPIs from D8.3 to monitor user satisfaction, service efficiency, and infrastructure impact.	Service performance benchmarks, user experience ratings, and infrastructure efficiency metrics.

## 2.5 EIRENE USER STRATEGY CYCLE

The EIRENE user strategy follows a dynamic and iterative cycle to ensure continuous adaptation and user engagement. Based on experiences of other RIs the role of outreach, feedback, and service optimization in enhancing the infrastructure’s accessibility and effectiveness.

The strategy cycle consists of five stages:

1. **Outreach and acquisition:** Engaging target user communities through tailored communication campaigns, workshops, and conferences to raise awareness of EIRENE’s services.
2. **Understanding user needs:** Conducting surveys, stakeholder consultations, and pilot testing to gather insights on evolving user demands and refine service offerings.
3. **Service delivery and experience:** Providing high-quality access to exposome data platforms, analytical tools, and training programs, ensuring seamless user interactions.
4. **Feedback and optimization:** Establishing structured mechanisms to collect user feedback and drive iterative improvements in service quality and accessibility.
5. **Expansion and refinement:** Using insights from pilot users to scale service offerings, optimize access systems, and strengthen user support mechanisms.

This strategy cycle ensures that EIRENE remains user-centred, adaptable, and aligned with real-world research and policy needs. By integrating structured feedback loops, performance monitoring, and stakeholder engagement strategies, EIRENE will foster long-term sustainability, innovation, and collaboration within the exposome research community.

## 3. IMPLEMENTING THE USER ACCESS AND SERVICE PROVISION SYSTEM FOR EIRENE

As EIRENE continues to develop its infrastructure and services during the Preparatory Phase (PPP), the primary focus is on designing a robust, flexible, and scalable user access and service provision system. Insights from relevant deliverables have guided this development to ensure that the system effectively serves a diverse user base while fostering transparency, accessibility, and collaboration. The user access framework must be efficient, interoperable, and adaptable to future advancements, providing seamless access to exposome-related data, analytical tools, and training resources (summarized in Table 3).

### 3.1 CENTRALIZED ACCESS VIA EIRENE WEB PORTAL

EIRENE aims to provide a centralized access point to its services and data through a user-friendly web portal. This platform will serve as a comprehensive hub, integrating various tools, datasets, and training opportunities in exposome research. During the Preparatory Phase, prototypes of this portal are being tested with pilot users to ensure usability, efficiency, and accessibility. A key aspect of this development is clear communication and training materials that facilitate user interaction with the portal's functionalities. The unified portal will support streamlined access to services, allow users to submit data requests, and offer tailored training programs, ensuring a seamless experience that directly responds to the recommendations outlined in Section 2.4, such as open access, user-centred design, and continuous feedback integration.

### 3.2 ACCESS TO DATA SERVICES AND DIGITAL TOOLS

Adhering to FAIR principles (Findable, Accessible, Interoperable, Reusable), EIRENE's data services are designed to support users in processing, visualizing, and analysing large datasets related to environmental exposures and health outcomes. Standardized workflows, coupled with ongoing user feedback, will be instrumental in refining the accessibility and effectiveness of these tools. The digital infrastructure will evolve based on pilot testing, ensuring that the data services and analytical tools meet the specific needs of the research community. The implementation of AI-enhanced analytical models and cloud-based storage will further improve the efficiency of data access and utilization.

### 3.3 TESTING PHYSICAL, REMOTE, VIRTUAL, AND HYBRID ACCESS MODES

EIRENE will pilot multiple access modes to allow users to interact with data and tools through physical, remote, virtual, and hybrid modalities. Early adopters are engaged in structured workshops, pilot projects, and virtual access trials to provide valuable feedback on the usability and efficiency of the services. A major focus is on ensuring interoperability with existing European research infrastructures, facilitating seamless collaboration, and enabling data sharing across institutions. These pilot activities will provide a foundation for refining the user access system and ensuring that it is well-integrated within the broader European research ecosystem.

### 3.4 SERVICE CATALOGUE DEVELOPMENT

A comprehensive service catalogue is being developed to list all available services, including data services, research support, and training programs. This catalogue will be dynamic and regularly updated with new tools and resources to keep pace with emerging research needs and technological advancements. Early prototypes of the catalogue feature user-friendly search functions and filtering options to enhance accessibility. The structured service catalogue will serve as a reference guide for users, ensuring they can easily identify and access relevant resources for their research and professional development.

### 3.5 USER FEEDBACK AND CONTINUOUS IMPROVEMENT

User feedback mechanisms play a critical role in shaping EIRENE's services. Surveys, stakeholder consultations, and structured pilot studies ensure that the system remains aligned with user expectations and technical requirements. Early feedback collected during pilot testing will help identify usability gaps and refine system functionalities. By implementing a continuous feedback loop, EIRENE will be able to address user concerns, enhance service quality, and optimize technical capabilities, ensuring a user-centred approach to service provision.

### 3.6 ACCESS MANAGEMENT AND USER SUPPORT

An Access Management Plan (AMP) is under development to define policies governing user eligibility, service access procedures, and data security. The plan will address the different types of access modes, including physical, remote, virtual, and hybrid. A dedicated helpdesk will be established to support users in navigating these access frameworks. This helpdesk will provide technical guidance, respond to user queries, and ensure that users can efficiently interact with EIRENE's data infrastructure and digital services.

### 3.7 USER TESTING AND PILOT ACTIVITIES

Similar to Transnational Access (TNA) pilots in other research infrastructures, EIRENE is conducting pilot activities involving selected early users. These pilots will test the effectiveness of service workflows, exposome data platforms, and training programs. Virtual meetings and consultations with key stakeholders will facilitate discussions on system design, access efficiency, and user satisfaction. The insights gained from these pilot activities will inform the refinement of user access strategies and help tailor services to the evolving needs of the scientific community.

By integrating structured access protocols, user feedback mechanisms, and iterative improvements, EIRENE ensures that its user access and service provision system is robust, scalable, and aligned with the needs of its diverse user community. The system will continue to evolve, incorporating new technologies and best practices to enhance accessibility, usability, and interoperability, laying a strong foundation for EIRENE's transition to full operational capacity.

Table 3 Summary of the implementation and respective KPIs

Section	Key Focus	Key Performance Indicator (KPI)
<b>Centralized access via Eirene web portal</b>	Developing a centralized web portal for seamless access to services and data, ensuring usability and efficiency through pilot testing.	User engagement metrics, portal traffic, and successful service requests.
<b>Access to data services and digital tools</b>	Implementing FAIR principles for data services, enhancing digital tools with AI and cloud-based storage for improved efficiency.	Data accessibility rate, user satisfaction with analytical tools, and AI-enhanced processing efficiency.
<b>Testing physical, remote, and hybrid access systems</b>	Piloting multiple access systems (physical, remote, hybrid) and ensuring interoperability with European research infrastructures.	Number of successful pilot access sessions, interoperability success rate, and user feedback ratings.
<b>Service catalogue development</b>	Creating a dynamic service catalogue with user-friendly search functions, listing all available data services, research support, and training.	Service catalogue completeness, frequency of updates, and user search success rate.
<b>User feedback and continuous improvement</b>	Establishing structured user feedback mechanisms to refine services and ensure alignment with user needs.	Number of feedback submissions, percentage of implemented user suggestions, and service quality ratings.
<b>Access management and user support</b>	Developing an Access Management Plan (AMP) to define policies for user eligibility, data security, and service access, supported by a dedicated helpdesk.	Helpdesk response time, access request resolution rate, and security compliance adherence.
<b>User testing and pilot activities</b>	Conducting pilot activities with early users to refine workflows, test exposome data platforms, and improve access strategies.	Success rate of pilot projects, stakeholder engagement levels, and system optimization based on feedback.

## 4. EVOLVING USER NEEDS - NEW SERVICES, METHODS, PARAMETERS FOR EXPOSOME RESEARCH

### 4.1 INTRODUCTION

The user strategy within EIRENE, as an exposome research infrastructure (RI), is focused on understanding and addressing the evolving needs of its diverse user community, which includes environmental health researchers, public health officials, policymakers, and industry stakeholders. The central mission of EIRENE is to provide access to high-quality, harmonized data and advanced tools that elucidate the links between environmental exposures and human health.

Remaining at the forefront of scientific developments is crucial for EIRENE, ensuring the continuous evolution of new services, methodologies, and data types related to the exposome—the totality of environmental exposures a person experiences throughout their lifetime. Drawing from pilot findings and structured access approaches, EIRENE will offer access to diverse datasets, including chemical pollutants, physical exposures, and biological markers, which are critical for understanding how environmental factors impact health outcomes.

EIRENE must proactively evolve its services, methodologies, and research parameters to align with scientific advancements and increase awareness of environmental determinants of health. The research community's growing focus on exposome science requires a research infrastructure integrating new technologies, high-quality datasets, and innovative analytical frameworks. To remain relevant and at the forefront of exposome research, EIRENE will refine its offerings through cutting-edge methodologies, advanced analytical tools, and dynamic research capabilities that align with international best practices.

### 4.2 KEY RESEARCH QUESTIONS

As the research community continues to expand its focus on exposome science, EIRENE will play a vital role in addressing key questions, such as:

- What are the primary environmental exposures contributing to the onset of chronic diseases, such as cancer and cardiovascular disease?
- How do combined exposures (chemical mixtures, physical stressors, and biological agents) influence long-term health?
- What role do environmental factors play in shaping health disparities among different populations?
- How can emerging contaminants (such as endocrine disruptors or microplastics) be detected early to prevent adverse health effects?

### 4.3 CONTINUOUS DEVELOPMENT: KEY ASPECTS FOR EIRENE

### **Understanding the complexity of the exposome**

The exposome represents a vast and intricate network of external and internal exposures. To address these complexities, EIRENE will develop methodologies such as metabolomics and non-targeted analysis (NTA), enabling researchers to detect unknown chemicals in biological samples and uncover novel links between environmental exposures and disease risk. Insights from pilot studies emphasize the need for precision tools and non-targeted capabilities.

### **Improving models for exposure and health impact assessments**

As exposomics advances, models used to evaluate the impact of environmental exposures on health must be refined. By integrating data on epigenetic modifications, the microbiome, and metabolomic profiles, EIRENE will enhance the precision of these models, enabling accurate predictions of health outcomes and risks at both individual and population levels. Feedback mechanisms will ensure the adaptability of these models to user needs.

### **Adapting to emerging challenges in environmental health**

The dynamic nature of environmental health research necessitates a flexible approach to address new challenges, such as persistent organic pollutants (POPs), nanomaterials, or climate-driven exposure patterns. EIRENE's evolving service catalogue incorporates feedback from stakeholders to monitor and analyse emerging contaminants, including microplastics in water and air or the health impacts of urban heat islands.

### **Enhancing monitoring and analytical capabilities**

Advances in sensor technology, omics platforms, and AI-driven analytics offer unprecedented opportunities for comprehensive exposure monitoring. EIRENE will provide access to tools like high-resolution mass spectrometry, next-generation sequencing, and wearable exposure sensors, allowing researchers to gather real-time data and achieve ultra-fine analytical resolutions. Prototypes tested in pilots will inform service scalability.

### **Addressing gaps in knowledge and filling data voids**

Despite significant advances, gaps remain in understanding the cumulative impacts of environmental exposures. EIRENE is committed to developing new datasets and analytical frameworks to fill these voids, particularly for non-communicable diseases such as diabetes, respiratory conditions, and neurodegenerative disorders, where environmental influences are not fully understood. Metrics from performance monitoring will help prioritize these efforts.

### **Tailoring solutions for diverse environments and populations**

EIRENE's services will address region-specific challenges, recognizing that environmental exposures vary across ecosystems and populations. By offering region-specific data and tools, EIRENE will help reduce environmental health disparities and support public health interventions tailored to local needs. This includes aligning with stakeholder feedback to address vulnerable populations' specific needs.

## **4.4 STRENGTHENING EIRENE'S ROLE IN EXPOSOME SCIENCE**

EIRENE's user strategy is built on anticipating future needs in exposome research and providing ongoing support for new services, data streams, and methodologies. By facilitating access to comprehensive data and developing innovative analytical tools, EIRENE will empower researchers to address pressing questions in exposome science. This will advance our understanding of environmental exposures' role in health and disease and support the development of effective public health interventions aimed at mitigating exposure-related risks.

To address the increasing concerns about emerging contaminants, EIRENE will enhance its monitoring frameworks to include the detection of microplastics, persistent organic pollutants, and endocrine-disrupting chemicals. These substances pose significant health risks, and their study requires the development of standardized methodologies that facilitate cross-disciplinary collaboration and harmonized data collection. By improving its analytical frameworks and ensuring interoperability with existing European infrastructures, EIRENE will support evidence-based policymaking and improve the predictive accuracy of exposure-health models.

Furthermore, EIRENE must enhance its ability to integrate data from diverse sources, including personal exposure monitoring devices, environmental sensor networks, and clinical research databases. This will enable a more precise and individualized understanding of exposure patterns and their potential long-term health effects. The use of artificial intelligence (AI) and machine learning algorithms to analyse complex datasets will be a crucial step in improving researchers' ability to detect patterns, identify at-risk populations, and inform targeted interventions.

Lastly, EIRENE will continue to refine its digital infrastructure by offering cloud-based data analysis platforms, interactive visualization tools, and real-time exposure tracking solutions. Ensuring that these tools remain accessible, adaptable, and scalable will be key to fostering a collaborative research environment that enables users to leverage EIRENE's services for diverse scientific inquiries.

By prioritizing innovation, integration, and user engagement, EIRENE will establish itself as a dynamic and indispensable infrastructure for exposome science, supporting groundbreaking research and facilitating a deeper understanding of environmental determinants of health.

## 5. SCALABLE USER SUPPORT SYSTEM AND FUTURE GROWTH

As EIRENE transitions from its preparatory phase to full operational capacity, establishing a scalable and adaptive user support system is essential. This system must ensure that services remain accessible, efficient, and responsive to the evolving needs of the user community. A well-structured approach to pilot programs, flexible infrastructure, stakeholder engagement, and sustainable funding mechanisms will be critical to achieving this goal. The following sections outline key strategies for developing and maintaining a resilient and future-ready user support system (Summarized in Table 4).

### 5.1 SCALABLE PILOT SUPPORT SYSTEM



During its preparatory phase, EIRENE is implementing a pilot-based approach to test and refine its user support system. This structured program provides early adopters with access to essential services while collecting feedback to drive iterative improvements. The pilot support system will develop a knowledge base that includes articles, case studies, and guidelines on exposome data analysis, statistical tools, and research methodologies. Additionally, interactive training sessions and webinars on key topics will help users develop the technical skills necessary to utilize EIRENE's resources effectively.

Technical support is another key component, with an email-based helpdesk and online consultation services available to guide users on data access and tool utilization. Stakeholder feedback mechanisms, such as surveys, focus groups, and direct consultations, should help refine digital platforms, access protocols, and service provision workflows. Through this structured pilot approach, EIRENE ensures that its support system is robust and user-centered while optimizing resource allocation during early-stage operations.

Technical support is another key component, with an email-based helpdesk and online consultation services available to guide users on data access and tool utilization. Stakeholder feedback mechanisms, such as surveys, focus groups, and direct consultations, should help refine digital platforms, access protocols, and service provision workflows. Through this structured pilot approach, EIRENE ensures that its support system is robust and user-centred while optimizing resource allocation during early-stage operations.

## 5.2 A FLEXIBLE AND ADAPTIVE FRAMEWORK

The long-term success of EIRENE's user support system depends on its ability to evolve alongside research demands. A modular and adaptive framework should allow EIRENE to integrate new services, tools, and capabilities without disrupting existing operations. This includes fostering interoperability with EU research infrastructures such as ELIXIR and EATRIS, enabling seamless data-sharing and analysis across multiple platforms. The digital infrastructure is expected to gradually expand from basic resource libraries to e-learning modules, real-time data visualization, and virtual collaboration workspaces.

As new analytical techniques and technologies emerge, EIRENE plans to integrate AI-driven data analytics, cloud-based storage solutions, and automated exposome risk assessment models. By designing a scalable and flexible system, EIRENE ensures long-term usability and sustainability while remaining relevant to the evolving needs of the scientific community.

## 5.3 PRIORITIZING USER ENGAGEMENT TO MEET USER NEEDS

Active engagement with stakeholders is crucial for ensuring that EIRENE's user support system meets real-world needs. A multi-channel engagement strategy will foster collaboration among researchers, policymakers, industry/business partners, and public health professionals. Regular communication through newsletters, updates, and case studies will keep users informed about new resources and

services. Virtual events, discussion forums, and interactive Q&A sessions will provide opportunities for direct engagement and feedback.

Social media platforms, such as LinkedIn, will facilitate knowledge exchange within the exposome research ecosystem, while pre-launch stakeholder workshops will align infrastructure goals with user expectations. Establishing a continuous feedback loop will ensure that infrastructure developments are driven by user needs and expectations, fostering a sense of community and collaboration.

#### 5.4 STRATEGIC PARTNERSHIPS FOR RESOURCES AND EXPERTISE

Collaborating with established research networks, industry leaders, and academic institutions will enhance EIRENE's capabilities and provide additional resources for sustainability. Partnerships with EU research infrastructures, such as BBMRI-ERIC for biobanking, will help standardize data management frameworks and ensure compatibility with broader research initiatives. Engagement with environmental monitoring and analytics companies and firms, and bioinformatics actors/organizations will facilitate the co-development of new research tools.

Academic collaborations will further strengthen EIRENE's training initiatives through joint programs, summer schools, webinars and capacity-building workshops. By leveraging existing expertise and infrastructure, EIRENE can accelerate development, reduce costs, and enhance its ability to provide high-quality user support.

#### 5.5 IMPLEMENTING CONTINUOUS MONITORING AND FEEDBACK

A structured feedback system is necessary to maintain the effectiveness of EIRENE's user support mechanisms. A dedicated User Advisory Group, comprising researchers, policymakers, and industry/business professionals, should provide structured recommendations for service improvements. Performance metrics will track user engagement, service accessibility, and research impact, ensuring that EIRENE remains responsive to emerging research challenges.

Regular user experience surveys should evaluate the effectiveness of training programs, digital tools, and service accessibility. These insights will inform iterative refinements to the platform, ensuring that the support system remains aligned with user needs. Continuous monitoring and data-driven decision-making should enhance long-term quality assurance and system efficiency.

#### 5.6 SUSTAINING USER ACCESS THROUGH STAKEHOLDER ENGAGEMENT AND FUNDING

To ensure the sustainability of its user support system, EIRENE should implement a diversified funding strategy. Horizon Europe grants and EU funding calls are expected to support infrastructure expansion, digital platform development, and transnational research collaborations. Strengthening relationships with national governments across Europe is intended to facilitate long-term funding agreements and promote financial stability.

Engagement with industry stakeholders can create additional funding opportunities through co-funding initiatives and sponsorships. Collaborations with environmental data analytics firms and biotechnology companies are likely to contribute to the development of new research tools while helping ensure that EIRENE’s user support system remains financially viable and scalable over time.

## 5.7 PLANNING FOR FUTURE GROWTH AND SCALABILITY

As EIRENE transitions to full operational capacity, it must proactively plan for growth to accommodate increasing user demand. A phased approach to infrastructure expansion should enable the progressive integration of new datasets, enhanced computational capabilities, and multilingual support. The expansion of training programs, recruitment of additional support staff, and the introduction of AI-driven assistance tools are expected to further strengthen user services.

The adoption of cloud-based infrastructure is intended to help EIRENE manage large-scale data storage, real-time processing, and advanced analytics efficiently. These scalable solutions should support EIRENE in maintaining its position as a leading resource in exposome science, capable of serving a growing and diverse user base. Future growth strategies are expected to prioritize accessibility, adaptability, and technological integration, ensuring that EIRENE continues to meet the needs of researchers, policymakers, and industry stakeholders.

This chapter provides a structured framework for the implementation, expansion, and sustainability of EIRENE’s user support system. By integrating pilot-driven development, adaptive digital tools, strategic partnerships, continuous monitoring, and long-term funding, EIRENE aims to establish a resilient, efficient, and future-ready research infrastructure for exposome science.

Table 4 Summary of scalable user support and future growth respective KPIs

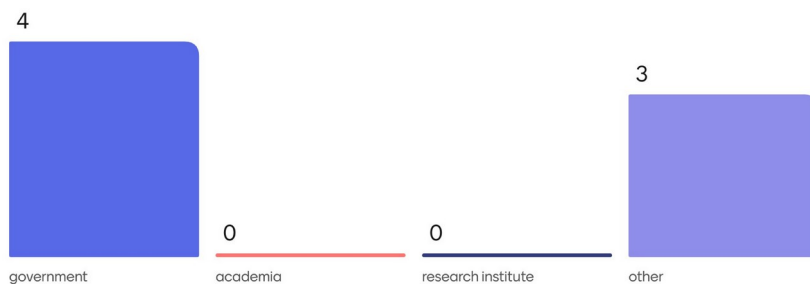
Section	Key Focus	Key Performance Indicator (KPI)
<b>Scalable pilot support system</b>	Pilot programs to refine user support, develop training materials, and provide technical assistance.	Number of pilot participants, knowledge base expansion, and training session attendance.
<b>A flexible and adaptive framework</b>	Modular and scalable framework integrating AI, cloud storage, and interoperable tools.	Service expansion success rate, interoperability with EU infrastructures, and AI adoption metrics.
<b>Prioritizing user engagement</b>	Multi-channel engagement with user via newsletters, virtual events, and social media.	User engagement levels, number of collaboration events, and social media outreach.
<b>Strategic partnerships for resources and expertise</b>	Partnerships with research networks, industry leaders, and academia to enhance service capabilities.	Number of strategic partnerships, joint research projects, and funding secured through collaborations.
<b>Implementing</b>	Operating a user helpdesk and	User satisfaction scores, number of

<b>continuous monitoring and feedback</b>	forum, supported by a User Advisory Group and continuous performance monitoring.	service refinements based on feedback, and engagement metrics.
<b>Securing funding for long-term sustainability</b>	Diversified funding strategy, including EU grants, national government support, and industry collaborations.	Funding diversity index, amount of secured grants, and industry co-funding participation.
<b>Planning for future growth and scalability</b>	Phased infrastructure expansion, cloud-based solutions, AI-driven tools, and multilingual support.	Infrastructure scalability index, increase in user base, and AI-assisted service efficiency.

Appendix. Workshops - Responses from users

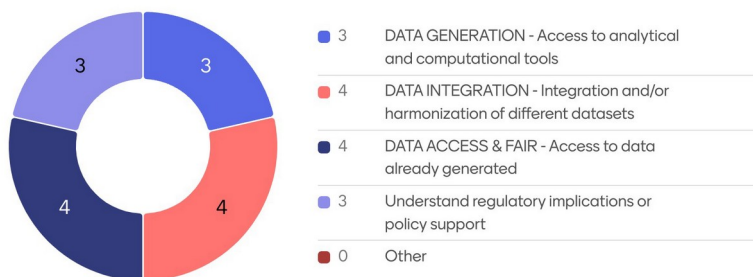
Question 01 out of 13

What is your main affiliation?



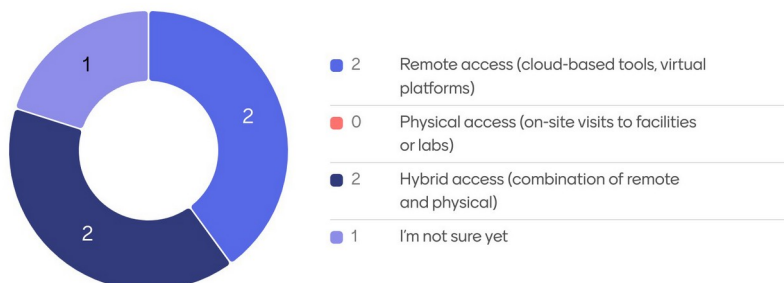
Question 02 out of 13

What challenges or needs do you currently face in exposome research that EIRENE could help with? (Select up to 3)



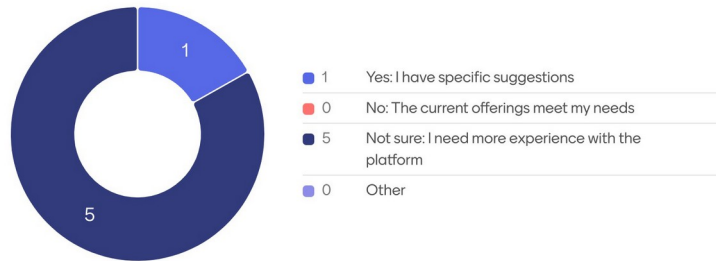
Question 03 out of 13

Which mode of access best suits your needs when using EIRENE's services?



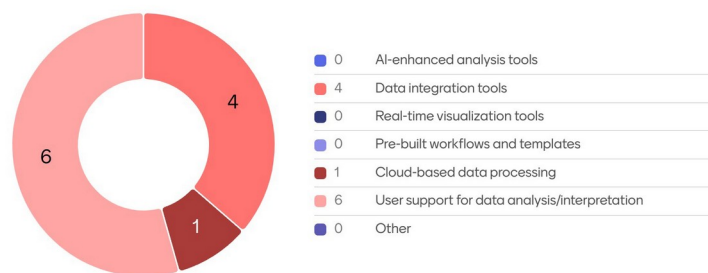
Question 04 out of 13

Are there any services or tools you feel are missing from EIRENE current offerings?



Question 05 out of 13

Which features are most important for improving your experience with exposome data analysis within EIRENE? (Select up to 3)



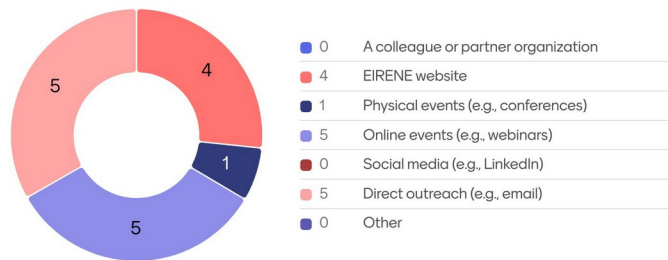
Question 06 out of 13

Which types of communication would most effectively engage you or your organization? (Select up to 3)



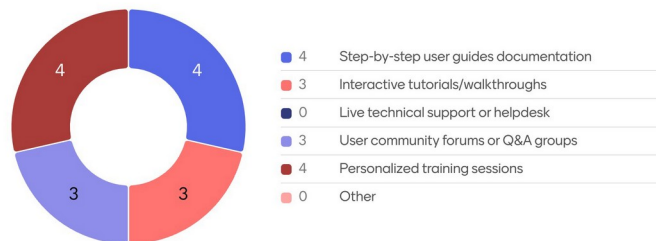
Question 07 out of 13

What is the best channel to inform about RI's like EIRENE? (Select up to 3)



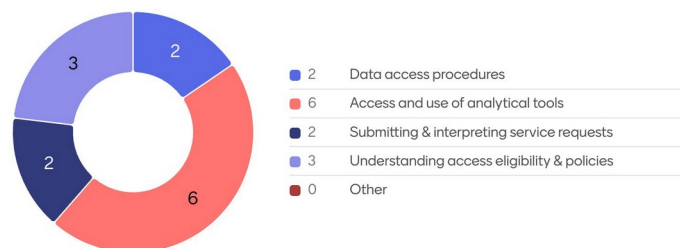
Question 08 out of 13

Which support mechanisms would improve your experience with RI's such as EIRENE? (Select up to 3)



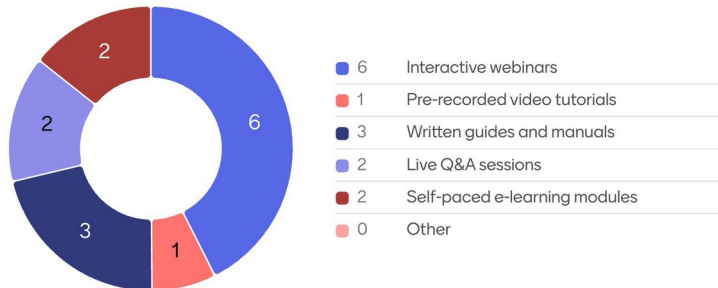
Question 09 out of 13

Which areas of EIRENE's services would benefit most from improved user guidance or training materials? (Select all that apply)



Question 10 out of 13

What format do you prefer for training materials provided by EIRENE? *(Select up to 3)*



Mentimeter

Question 11 out of 13

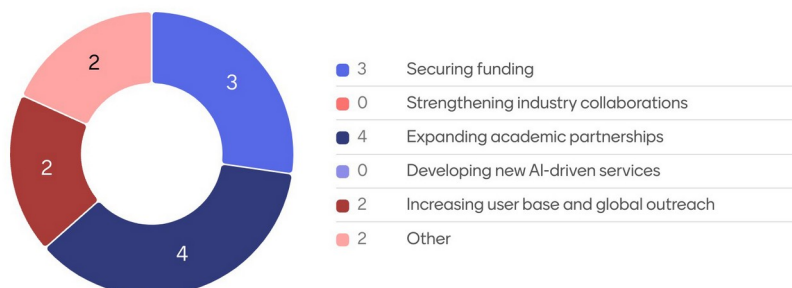
Which types of partnerships would you like to see EIRENE prioritize to enhance its user support? *(Select up to 3)*



Mentimeter

Question 12 out of 13

Which of the following should be prioritized to ensure EIRENE's long-term sustainability? *(Select up to 3)*





Question 13 out of 13

What would make you more likely to participate in pilot testing or early user activities? *(Select up to 2)*

